MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

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WARREN DE LA RUE, Esq., President, in the Chair.

Capt. Oliver Haldane Stokes, R.E., Co. Kerry, Ireland;
Henry Samuel Williams, Esq., Cambridge; and
William Jardine, Esq., 8 King's Bench Walk, Temple,

were balloted for and duly elected Fellows of the Society.

On the Determination of the Difference of Longitude between the Observatories of Greenwich and Glasgow by Galvanic Signals. By Professor Grant, F.R.S.

One of the earliest objects which I had in view after obtaining the definitive control of this Observatory in May 1860, was to take steps for effecting a new determination of the longitude of the Observatory relatively to the Royal Observatory, Greenwich, by means of some one or other of the various methods founded upon the transmission of galvanic signals, which have been used so extensively and with so much success in recent years both in the new and the old world.

But an impediment of a serious nature offered itself at the

outset to the execution of any operation of this kind. The distance between the Observatory and the nearest telegraph station in the city of Glasgow was nearly three miles. Consequently, an electric communication could not be established with Greenwich until this hiatus was traversed by a wire, and one too which would necessarily have to pass over the roofs of the houses throughout almost the whole of its course. Fortunately, the negotiations for supplying the city of Glasgow with the advantages of correct time resulted in the Observatory obtaining the means of enabling it to overcome this difficulty. Towards the close of the year 1863 a metallic connexion was finally established between the Observatory and the office of the British and Irish Magnetic Telegraphic Company, which possesses the patent right of Jones's method of regulating clocks, and which has since been extensively employed in carrying that method into effect in Glasgow in concert with the Observatory. Shortly afterwards, having brought before the notice of the Astronomer Royal the desirableness of determining by galvanic signals the longitude of the Glasgow Observatory, Mr. Airy very kindly and liberally offered to place the resources of the Royal Observatory at our disposal, with a view to the accomplishment of this object, as soon as a convenient occasion presented itself for conducting the operations.

The next step was to obtain from one of the principal Telegraph Companies the temporary use of a wire from Glasgow to London, with the view of establishing an unbroken electric communication between the two Observatories. This was speedily effected by the good offices of Mr. F. G. Varley, the Engineer of the Electric and International Telegraph Company, who, happening to be in Glasgow at the time when the project was beginning to acquire shape, at once entered warmly into our views, and upon his representations the Company to which he is attached most obligingly assigned to us the use of one of their through wires during the whole time that it would be required for the undertaking.

The Astronomer Royal having kindly submitted to my choice several modes of conducting the operation, I selected for that purpose the method of double registration, which has been practised so successfully in the United States of America and more recently in Europe. The principle of this method is extremely simple. When a star passes each of the successive wires of the transit telescope of the more eastern of the two Observatories, the observer, by tapping a key with his finger, completes a galvanic circuit, and the instant of transit is recorded on the chronographic apparatus of the Observatory; but the galvanic current, instead of going to earth, is made to pass along the line wire to the recording apparatus of the distant observatory, upon which also the instant of transit is in the same way recorded. A process exactly similar is re-

peated when the star comes to the meridian of the more western observatory, the instant of transit being registered on both chronographic apparatuses by the same completion of the galvanic circuit. In this manner each signalling star supplies two pairs of recorded times of transit, a comparison of the individual values of which give two distinct results, the one indicating the difference of longitude between the two observatories, and the other assigning a value of the time occupied by the galvanic current in its passage from the one observatory to the other.

The batteries and the recording apparatus used at this Observatory were courteously lent to us for the occasion by the Electric and International Telegraph Company. The insulations continued perfectly satisfactory throughout the whole period of the operations; the working of the chronographic apparatus temporarily used by us was also everything that could be desired.

In order that we might the more easily understand each other at the two Observatories, Mr. Varley made arrangements by which each Observatory was supplied with a speaking clerk from the Electric and International Telegraph Company on every night of observation.

The period of operations extended from April 28 in the present year to May 26.

The stars selected for observation amounted in number to twenty-eight, and were arranged in four groups of seven stars each, and in such a manner that when the last star of any group had passed through the telescope of the Glasgow Transit Circle, which was the more western instrument, the first star of the succeeding group was nearly about to commence its passage over the wires of the Greenwich or more eastern instrument.

The weather on the whole was not favourable for simultaneous observations at both Observatories during the period of four weeks over which the operations extended. In several instances observations were made at Greenwich which could not be responded to from Glasgow, and in one or two instances the converse of this happened. On four nights, however—May 1, May 2, May 22, and May 25—the sky was favourable for observation at both Observatories, and it is upon the results obtained on those nights that the determination of the difference of longitude contained in this paper is exclusively based.

The observers at Greenwich were Mr. Dunkin, Mr. Criswick, and Mr. Carpenter; the observer at Glasgow was Mr. Plummer. The observations of Mr. Criswick and Mr. Carpenter have been reduced to those of Mr. Dunkin by taking into account their relative personal equations, the latest determinations of which have been kindly forwarded to me by the Astronomer Royal. The observations of Mr. Plummer, whose personal equation was also determined at Greenwich, have similarly been reduced to those of Mr. Dunkin.

The following are the results of the operations :—

May 1.

Star.	Excess of Glasgow over Greenwich Time of Transit as recorded on Greenwich Chronograph. m	s
B.A.C. 4662	17	10·73
τ Virginis		10·87
d Boötis		10·82
26 Boötis		10·81
σ Boötis		10·64
Lalande 26696		10·67
B.A.C. 4846		10·73
Lalande 26816		10·55
o Boötis		10·64
Lalande 26975		10·57
Mean Difference ...	17	10·703 ... (A)

Star.	Excess of Glasgow over Greenwich Time of Transit as recorded on Glasgow Chronograph. m	s
B.A.C. 4662	17	10·74
τ Virginis		10·75
d Boötis		10·78
26 Boötis		10·68
σ Boötis		10·68
Lalande 26696		10·57
B.A.C. 4846		10·76
Lalande 26816		10·49
o Boötis		10·58
Lalande 26975		10·55
Mean Difference ...	17	10·658 ... (A′)

Hence combining (A) and (A′), we have

	m	s
Difference of Longitude ...	17	10·680
Time of Current's Passage ...		0·023

May 2.

Star.	Excess of Glasgow over Greenwich Time of Transit as recorded on Greenwich Chronograph. m	s
τ Virginis	17	10·77
Lalande 25818		10·62
Lalande 25892		10·73
Lalande 25943		10·63

Star.	Excess of Glasgow over Greenwich Time of Transit, as recorded on Greenwich Chronograph. m s
d Boötis	17 10·52
26 Boötis	10·70
σ Boötis	10·69
Lalande 26696	10·72
B.A.C. 4846	10·62
Lalande 26816	10·54
o Boötis	10·60
Lalande 26975	10·75
Lalande 27718	10·70
ϱ Serpentis	10·85
40 Serpentis	10·77
γ Serpentis	10·79
Lalande 29100	10·61
5 Herculis	10·72
45 Serpentis	10·73
Mean Difference ...	17 10·685 ... (B)

Star.	Excess of Glasgow over Greenwich Time of Transit as recorded on Glasgow Chronograph. m s
92 Virginis	17 10·56
B.A.C. 4662	10·62
τ Virginis	10·74
Lalande 25818	10·56
Lalande 25892	10·66
Lalande 25943	10·51
d Boötis	10·50
26 Boötis	10·60
σ Boötis	10·61
Lalande 26696	10·62
B.A.C. 4846	10·59
Lalande 26816	10·47
o Boötis	10·55
Lalande 26975	10·70
Lalande 27718	10·60
ϱ Serpentis	10·64
40 Serpentis	10·66
γ Serpentis	10·69
Lalande 29100	10·57
5 Herculis	10·66
45 Serpentis	10·73
Mean Difference ...	17 10·611 ... (B′)

Combining (B) and (B′), we have

		m	s
Difference of Longitude	...	17	10·648
Time of Current's Passage	...		0·037

May 22.

Star.	Excess of Glasgow over Greenwich Time of Transit as recorded on Greenwich Chronograph. m	s
σ Bootis	17	10·55
Lalande 26975		10·49
Lalande 27718		10·42
3 Serpentis		10·58
Lalande 27885		10·58
6 Serpentis		10·50
8 Serpentis		10·42
τ Serpentis		10·50
10 Serpentis		10·35
ϱ Serpentis		10·35
γ Serpentis		10·46
5 Herculis		10·52
45 Serpentis		10·36
Mean Difference ...	17	10·468 ... (C)

Star.	Excess of Glasgow over Greenwich Time of Transit, as recorded on Glasgow Chronograph. m	s
σ Boötis	17	10·44
Lalande 26975		10·40
Lalande 27718		10·42
3 Serpentis		10·56
Lalande 27885		10·49
6 Serpentis		10·42
8 Serpentis		10·33
τ Serpentis		10·44
10 Serpentis		10·27
ϱ Serpentis		10·30
γ Serpentis		10·47
5 Herculis		10·36
45 Serpentis		10·27
Mean Difference ...	17	10·398 ... (C′)

Combining (C) and (C′), we have

		m	s
Difference of Longitude	...	17	10·433
Time of Current's Passage	...		0·035

May 25.

Star.	Excess of Glasgow over Greenwich Time of Transit, as recorded on Greenwich Chronograph. m	s
26 Boötis	17	10·52
σ Boötis		10·31
Lalande 26696		10·41
B.A.C. 4846		10·48
Lalande 26816		10·55
o Boötis		10·48
Lalande 26975		10·38
Lalande 27718		10·61
3 Serpentis		10·49
Lalande 27885		10·51
6 Serpentis		10·42
8 Serpentis		10·33
τ Serpentis		10·57
10 Serpentis		10·48
40 Serpentis		10·48
γ Serpentis		10·48
5 Herculis		10·76
Lalande 29261		10·54
45 Serpentis		10·32
Mean Difference ...	17	10·480 ... (D)

Star.	Excess of Glasgow over Greenwich Time of Transit, as recorded on Glasgow Chronograph. m	s
26 Boötis	17	10·47
σ Boötis		10·35
Lalande 26696		10·36
B.A.C. 4846		10·41
Lalande 26816		10·52
o Boötis		10·43
Lalande 26975		10·37
Lalande 27718		10·57
3 Serpentis		10·48
Lalande 27885		10·48
6 Serpentis		10·40
8 Serpentis		10·31
τ Serpentis		10·52
10 Serpentis		10·50
40 Serpentis		10·50
γ Serpentis		10·50

Star.	Excess of Glasgow over Greenwich Time of Transit, as recorded on Glasgow Chronograph.
	m s
5 Herculis	17 10·61
Lalande 29261	10·43
45 Serpentis	10·24
Mean Difference ...	17 10·445 ... (D′)

Combining (D) and (D′), we have

	m s
Difference of Longitude ...	17 10·463
Time of Current's Passage ...	0·018

Collecting together the mean values of the difference of longitude for the four days, we have

	Difference of Longitude. m s
May 1	17 10·680
2	10·648
22	10·433
25	10·463

Combining these together with a due regard to the number of observations on each day, we obtain for the definitive value of the longitude of the Transit Circle of the Glasgow Observatory,

$17^m\ 10^s{\cdot}55$ W.

Similarly, for the time of the current's passage,

	s
May 1	0·023
2	0·037
22	0·035
25	0·018

Whence we obtain definitively

Time of Current's Passage = $0^s{\cdot}029$

I cannot omit this occasion of expressing my warmest acknowledgments to the local Officials of the Electric and International Telegraph Company, who, from Mr. Evans, the Superintendent, downwards, were most courteous and obliging, and rendered us very efficient aid in the course of our operations.

The Observatory, Glasgow, Nov. 9, 1865.

To illustrate Mr. Dawes' Paper in the Monthly Notice for June 1865.

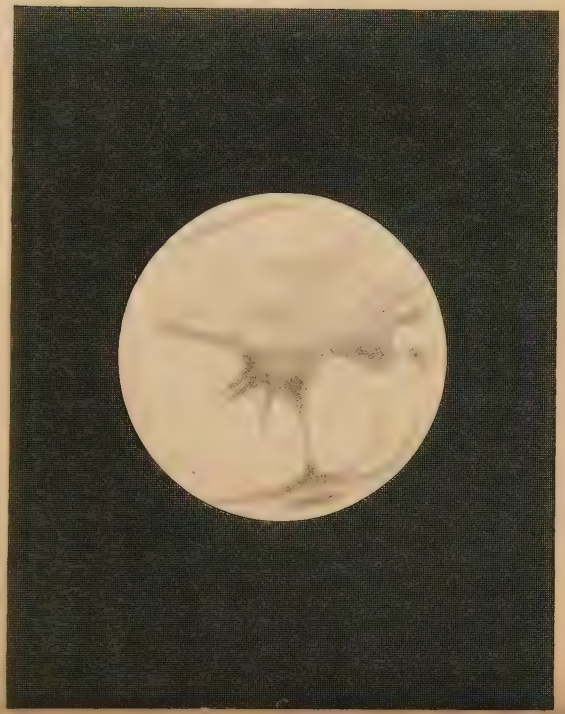
2

White almost glistening. About 25° or 30° on each side of b greenish white. Very light green

4

To illustrate Mr. Dawes' Paper in the Monthly Notice for June 1865.

10



12

b Greenish white for about 30° on each side of b.

a Greenish white.

reenish white.

1864. Nov. 10. G.M.T. 12h 6m

a Glistening white a small spot at times moderately well defined.

1865. Jan.y 21 G.M.T. 8h 0m

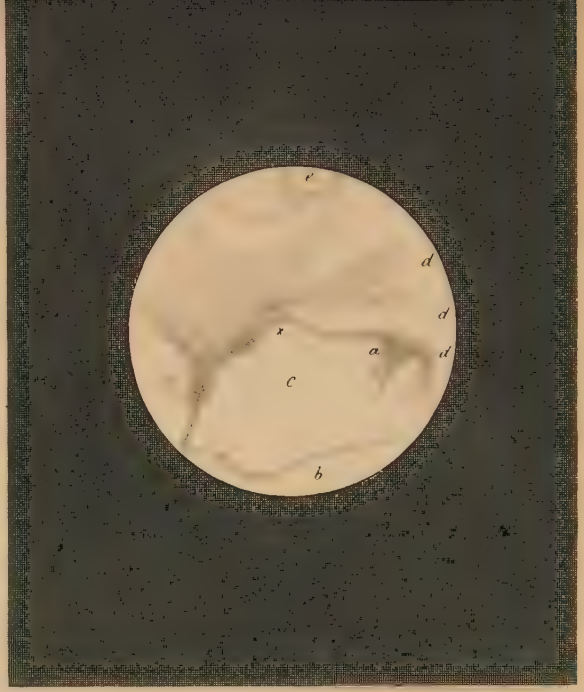
MARS

Hopefield Observatory, Haddenham, Bucks.

Aperture 8.0 in. Power 258.

J. Basire sc

1864. Nov. 26. G.M.T. 11h 46m



1864. Nov. 20. G.M.T. 11h 36m

a. Remarkably white & whitish all along the edge of the coast from the large Cape a little west of the Centre marked. X.
b Greenish white
c Light Orange.
d,d,d. Greenish white.
e Whitish a small roundish spot near the south pole

MARS

Hopefield Observatory, Haddenham, Bucks.

Aperture 8.0m Power 258

J. Basire sc.

On the Telescopic Disks of Stars. By E. J. Stone, Esq.

This subject having lately excited some attention amongst the Fellows of this Society, it may be worth while to recall what theory really says upon the point.

Theory informs us that if a pencil of homogeneous light diverge from one point, and after refraction through a lens, with circular aperture, converge accurately to a focus, then, instead of a single point of light at the focus, we have a small disk of light, the intensity of the illumination of which rapidly degrades to a ring of absolute blackness, then increases to a ring of maximum illumination, then decreases to a ring of absolute blackness, and so on for many alternations; the illumination, however, at the different maxima degrades with such rapidity that at the first, second, and third maximum, we have respectively the $\frac{1}{57}$th, $\frac{1}{240}$th, and $\frac{1}{620}$th of the illumination at the centre of the disk. (See Professor Airy's Paper, *Camb. Trans.* vol. v.) If we call these rings of absolute blackness and maximum intensity dark and bright rings respectively of the first, second, &c. order, theory proves that the angular radii, at the centre of the lens, of a ring of any order, is independent of the focal length of the lens, and varies inversely as the radius of the aperture. The theoretical law of the degradation of the brightness of the central disk is exhibited in the following table, which is calculated with 0·000022 inch for the wave length. The intensity at the centre of the disk is taken as the unit, and the angular distance between the centre and the first black ring is divided into twenty equal parts, for each of which the intensity is given.

Table.

	Illumination.		Illumination.
1	1·0000	11	0·3326
2	0·9903	12	0·2554
3	0·9606	13	0·1879
4	0·9134	14	0·1312
5	0·8503	15	0·0857
6	0·7746	16	0·0511
7	0·6897	17	0·0267
8	0·5994	18	0·0111
9	0·5075	19	0·0028
10	0·4175	20	0·0000

An inspection of this table shows that for some considerable distance from the black ring the intensity of the light is exceedingly feeble as compared with that at the centre. Consequently, it by no means necessarily follows from the theory that the angular diameter of the visible disk varies

inversely as the radius of the aperture. It would be a consequence of the theory, if the visible disk always extended sensibly to the first dark ring, but this is certainly not true, for if so, the apparent disk of a faint star would be as great, under the same circumstances of vision, as that of a bright star. The visible disk would also vary inversely as the radius of the aperture, provided that, under the circumstances of vision, the theoretical disk, which extends to the first black ring, should be always proportionably contracted.

When an image of a star is formed by an object-glass well corrected for spherical and chromatic aberration, the conditions required by the theory are satisfied, except that the presence of rays of different wave lengths complicates the phenomena by introducing coloured rings which will not be considered here. It would appear, then, that, if we should attempt to compare the measures of star-disks made with telescopes of different apertures, theory would not necessarily require these measures to be in the exact inverse ratios of the radii of the apertures. It would, however, require that any diminution of brightness in the image, any increase of magnifying power applied to the telescope, should be followed by a tendency in the measures to come out smaller.

The well-known contraction of the images of a star, when haze passes over the star, is one illustration of a diminution of brightness followed by a decrease in the apparent size of the disk; and with respect to the effects of increasing the magnifying power, which comes to the same thing, we cannot do better than quote some remarks by Mr. Dawes, in the *Astr. Nach.* No. 1552. "The telescopic star-disks do not increase in proportion to the power employed on the same aperture; and, consequently, up to a certain limit, the separation of disks (in his crystal micrometer) increases with the magnifying power."

At the June Meeting of this Society, Mr. Dawes stated "that he had often measured the disks of stars with a double-image micrometer formed of double refracting crystal, and that, under *similar circumstances*, he found the measured disks to depend wholly and entirely on the aperture of the telescope."

This statement of Mr. Dawes was claimed as a verification of the undulatory theory.

I think enough has been said to prove the extreme delicacy of any attempt to verify the theory by the measurement of star-disks. The inquiry is here complicated by our ignorance of what theoretical illumination is under given circumstances required to constitute the visible boundary of the image.

It would, at least, be necessary to know more exactly the force of, "under similar circumstances," before claiming Mr. Dawes' statement as a verification of theory. We should require to know whether all the observations were made with the same crystal micrometer, and whether the same eye-piece

was always used, or if the eye-pieces were changed so as to secure the same magnifying power on the different telescopes, if the law was found to hold true over any considerable range of powers. If Mr. Dawes has any accurate observations on the apparent magnitudes of star-disks, their publication would be a great boon to all interested in the subject of physical optics.

1865, *Nov.* 7.

In the discussion on this paper,

Mr. Pritchard asked whether Mr. Stone considered that the diameter of the spurious disk in some degree depends upon the perfection of the object-glass; and whether, if the spherical aberration in one telescope were better corrected than in another, it would, *cæteris paribus*, have a tendency to reduce the size.

Mr. Stone replied in the affirmative.

Mr. Pritchard observed that he had been induced to ask the question because Mr. Dawes had stated that the size depended, *cæteris paribus*, entirely upon the aperture, which was quite in accordance with theory. A conversation took place between himself and Professor W. H. Miller, of Cambridge, wherein reference was made to some object-glasses made by Dr. Steinheil, who, according to Professor Miller, had stated that he had made object-glasses of such perfect form and material, that the spurious disk of the stars became so large that for double-stars, which appeared to be divided when viewed through ordinary telescopes, the spurious disks were so expanded that a dark glass was necessary to see whether they were divided or not!

The speaker added that the spurious disk of a star diminishes very rapidly in brightness towards the edge. No doubt the more diaphanous the material, the less light will be absorbed, and the larger the spurious disk will (so far) appear; but the glass must be diaphanous beyond all precedent for any one to be able to measure the difference in the size of the disk. In fact, measurement can scarcely apply to the spurious disk. It depends partly upon the light of the sky; and any illumination in the telescope would diminish it. Mr. Pritchard thought that, for the purposes of measurement, we must look to the diameter of the first ring, and he would ask whether Mr. Stone had measured the diameter of the brightest part of that ring; and if so, whether it did or did not vary inversely with the aperture. If it did not, then the undulatory theory must be re-examined, as there was a residual phenomenon from which something was yet to be learned. As far as the effects of spherical aberration are concerned, he (Mr. Pritchard) was

perfectly sure that there never was a tolerable telescope made in modern times which had the slightest influence upon the diameter of the spurious disk. A telescope possessing an amount of spherical aberration that would interfere with the diameter of the disk would be such a telescope as no honest man would venture to sell, and no skilful man trouble himself to use. The diameter of the brightest part of the first ring he looked upon as an *experimentum crucis* of that part of the undulatory theory; he was, therefore, desirous of hearing Mr. Stone's opinion upon the subject.

Mr. Stone remarked, in reply, that he had never made any such measurement. At the last Meeting some references which he believed to be quite illusory were made to the question, and the only object he had in writing his paper was to point this out. The undulatory theory only referred to the rings of absolute blackness and maximum illumination, and with regard to those no doubt it was true; but as to verifying the theory by mere measures of the disk, he believed it would be fallacious.

On Personal Equation in Reading Microscopes.

By E. J. Stone, Esq.

In the *Monthly Notices* of the Royal Astronomical Society 1865, May 12, is an abstract of an interesting paper by Mr. Dunkin, "On some Peculiar Instances of Personal Equation." One of these illustrations is obtained as follows: Mr. Dunkin has selected from the "Greenwich Results" the observations of *Polaris* and *Polaris S.P.*, made by Messrs. Dunkin, Ellis, Criswick, Lynn, and Carpenter, all experienced observers; from the discrepancies of the results of the observations made by each observer above and below the pole, Mr. Dunkin has deduced corrections to the adopted colatitude, and has considered each observer to have his own colatitude.

The results thus obtained are as follows:—

From Mr. Dunkin's observations ...	...	38°	31′	21″·81
,, Mr. Ellis's ,, ...	...	38	31	22·01
,, Mr. Criswick's ,, ...	...	38	31	21·92
,, Mr. Lynn's ,, ...	...	38	31	21·64
,, Mr. Carpenter's ,, ...	...	38	31	21·48

The difference between the results thus obtained from the observations of Messrs. Ellis and Carpenter is seen to amount to 0″·53.

On the night this paper was read, I offered to the Meeting what I considered the explanation of these anomalous results, an explanation, however, perfectly in accordance with the general result of Mr. Dunkin's paper "that personality does exist in the reading of microscopes," and, in fact, a necessary consequence of the existence of such personality; and finding that explanation borne out by a numerical investigation, I have thought it worth while to place it on record.

The stability of the Greenwich Transit Circle is such that the reading corresponding to the zenithal position of the telescope remains sensibly unchanged for considerable periods of time; it has been usual to put together all the determinations of zenith-point reading made in a fortnight, and to adopt the mean result for the zenith-point reading in the reduction of all observations made during that fortnight.

The observing with the Transit Circle is distributed with great regularity amongst the assistants. If therefore, we call the differences of habit in reading the microscopes between any one observer and the mean habit of all the observers the personal equation of that observer, it will follow from the course adopted at Greenwich that the adopted readings for the zenithal position of the telescope will be free from personal equation, but that the resulting observations in N.P.D. will be affected with the personal equation of the observer, consequently the difference between the reading corresponding to the zenithal position of the telescope and the reading corresponding to the polar position of the telescope, as determined from the observations of any one observer, will be affected with the personal equation of the observer in opposite sign.

If this explanation is correct, the mean of all the results, which is the colatitude adopted at Greenwich, is free from the error of personality, and of course if the same observer determines the zenithal position and polar position of the telescope, the colatitude is free from personal equation; this is on the assumption that the observer's personal habit does not sensibly change in reading off different divisions of the circle.

In order to test this explanation numerically, I have found the differences between the nadir-point determinations made by Messrs. Dunkin, Ellis, Criswick, and Carpenter; to do this I have compared all the derminations made by these gentlemen during the year 1861 and 1862. I find

Mr. Dunkin's Reading for Nadir	— Mr. Ellis's ditto	$= +0''.30$
,, ,,	— Mr. Criswick's ditto	$= +0''.04$
,, ,,	— Mr. Carpenter's ditto	$= -0''.35$

There were not a sufficient number of Mr. Lynn's observations to determine his personal equation.

We thus have for the personal equations,

D. = 0·00
E. = + 0·30
C. = + 0·04
J.C. = − 0·35

And applying these results, with changed signs, to the colatitudes deduced by Mr. Dunkin, we have for the resulting colatitudes,

From Mr. Dunkin's observations	...	...	38° 31′ 21″·81
,, Mr. Ellis's ,,	...	...	38 31 21·71
,, Mr. Criswick's ,,	...	...	38 31 21·88
,, Mr. Carpenter's ,,	...	...	38 31 21·83

The agreement between these results is very close indeed. It appears that Mr. Ellis's and Mr. Carpenter's habits of reading microscopes, although very different, do not sensibly vary with the part of the circle used. It may be mentioned that Mr. Carpenter is longer sighted than Mr. Lynn, Mr. Lynn than Messrs. Dunkin and Criswick, and Messrs. Dunkin and Criswick than Mr. Ellis. It is impossible, on account of changes of temperature, to keep the graduations of the circle and the microscope-wires always at the same time perfectly in focus. I am inclined to think that the amount of personality in reading the microscopes would be much diminished, if the wires and graduations were always seen under exactly similar optical circumstances.

Upon the question of Personal Equation some discussion took place.

Mr. Pritchard mentioned the case of a great practical philosopher whom he had known, who was not able to bisect twice running within three seconds, and he doubted whether anybody in the room not habituated to observe, would be able to avoid a similar mistake. On the other hand, he had tested the eyes of the late Mr. Andrew Ross, the microscope-maker, some years ago. Mr. Ross was not accustomed to astronomical observations, and yet he bisected a division of a circle ten times, without making a difference of a 10th of a second.

Professor Challis mentioned an instance of an assistant at the Cambridge Observatory, who was a very good and consistent observer, but in bisecting with a microscope his results were always erroneous, about $\frac{3}{10}$ or $\frac{4}{10}$ of a second.

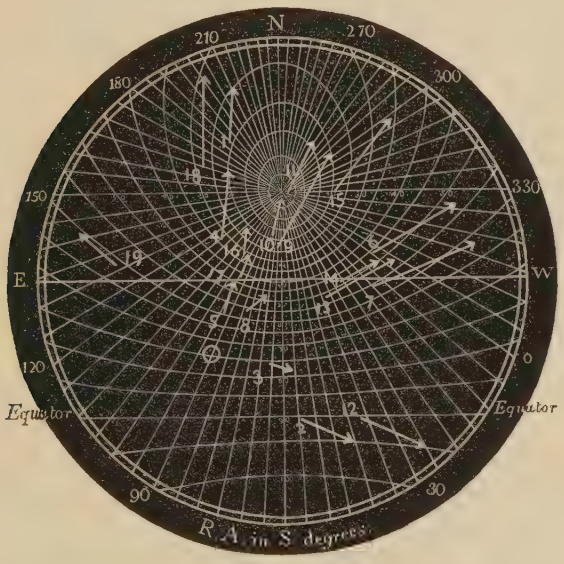
Mr. Dunkin gave another noteworthy instance, which came under his eye only a few days previously; and at the end of the discussion which took place upon the subject, Mr. De La Rue concluded by calling attention to the importance

of making such comparisons so as to eliminate personal error. We were too apt to look upon graduated instruments as leading to almost absolute perfection in observation. But we must always bear in mind that the eye forms part of the instrument and must take that into consideration.*

Radiant Points of Shooting-Stars. By A. S. Herschel, Esq.

The following remarks relate to a meteoric shower of some intensity, and displaying a remarkably radiant definite point, observed at Hawkhurst on the 20th of October, 1865.

On the nights of the 16th–18th of October, the sky at Hawkhurst was overcast, with constant rain. On the night of the 19th, a watch was kept for forty-five minutes, until eleven o'clock, but, although the sky was clear, without seeing any meteors directed from the known radiant point in *Orion*. On the night of the 20th the sky was cloudless, and on the watch being resumed, the



* An artist of celebrity expresses a doubt regarding the existence of personal equation in the estimation of the bisection of a division of a circle. A reading microscope, free from parallax, is in process of construction; great attention will be paid to the cleanness of the cut, to the illumination, and to the regulation of the emergent pencil; and then the Members of the Society will be able to make the experiment themselves at an evening meeting.—[C. P.]

occurrence of this meteoric shower was immediately apparent. Owing to their leaving remarkably luminous streaks, the tracks of nineteen meteors, described in the following list, could be noted among the stars with somewhat more than ordinary precision. Projected upon a plane-perspective planisphere of the sky (see figure), having the zenith of Greenwich for the centre of the projection, these nineteen tracks, with three exceptions, when prolonged backwards, pass through a small circle having a radius of only four degrees, and having its centre situated at *ν Orionis*, in R.A. 90°, N. Decl. 15°. In the following table the deviation of each meteor from the general radiant point; or the least distance of the great circle of its apparent path, prolonged backwards, from this point, is given in the last column of the table:—

No.	G.M.T. 1865. Oct. 20.	Mag. Compd with Stars.	Length of Path.	Streak Duration.	Streak Duration.	Began. R.A.	Began. N. Decl.	Ended. R.A.	Ended. N. Decl.	Deviation.
	h m		°	sec.	sec.	°	°	°	°	°
1	10 30	3	9	0·4	...	189	69	210	65	2·8
2	10 43	3	14	0·7	...	53	0	40	−5	3·0
3	10 58	2	9	0·8	1	67	14	58	12	2·8
4	11 6	3	21	0·8	1	125	61	171	70	0·2
5	11 19	3	15	0·7	2	92	29	95	45	0·2
6	11 22	2	39	0·9	3	15	46	333	37	2·0
7	11 31	2	30	0·8	3	16	35	342	28	0·1
8	11 36	4	13	0·6	1	81	32	73	44	0·4
9	11 40	3	41	0·9	2	70	66	297	70	0·6
10	11 41	3	22	0·7	2	84	68	17	89	3·0
11	11 43	3	18	0·6	1	17	89	276	73	4·0
12	11 48	2	24	0·8	2	38	0	17	−7	0·2
13	11 54	2	26	0·7	2	33	39	357	37	0·0
14	12 0	3	16	0·5	1	23	40	2	38	0·0
15	12 4	3	17	0·6	1	322	70	303	56	9·5
16	12 18	4	9	0·4	1	101	59	109	68	1·8
17	12 25	5	6	0·4	...	95	45	99	60	1·2
18	12 29	2	17	0·6	2	164	62	201	61	5·0
19	12 33	2	8	1·0	...	130	29	141	29	6·0
	Average Values		19	0·68	1·3					2·2

The mean deviation is 2°·2: but if the three most perturbed of these nineteen meteoric tracks (Nos. 15, 18, and 19) are omitted, the mean deviation from the general radiant point, of the sixteen remaining meteors is only 1°·4. The deviations of fourteen meteors from their common radiant point, observed on the 18th of October, 1864 (*vide Monthly Notices* for 1864, December 9), were in the same manner as follows:—

Ref. No.	Deviation.	Ref. No.	Deviation.	Ref. No.	Deviation.	Ref. No.	Deviation.
	°		°		°		°
1,	2·8	5,	3·0	9,	1·8	13,	1·5
2,	2·5	6,	0·4	10,	6 0	14,	0·2
3,	0·3	7,	1·7	11,	10·6	Mean Deviation	2·9
4,	0·0	8,	3·0	12,	7·2		

If the three most perturbed of these fourteen meteoric tracks (Nos. 10, 11, and 12) are omitted, the mean deviation from the common radiant point of the eleven remaining meteors is only 1°·6. Collecting together the results of both years' observations, we are thus enabled to give the position of this radiant point in the following definite, tabular form: —

Radiant O. Date of Observation.	Position. R.A.	Position. N. Decl.	No. of Meteors Observed.	Mean Deviation.
	°	°		°
1864, October 18	90	16	11	1·6
1865, October 20	90	15	16	1·4

As the meteors of this shower will probably be observed every year, it will be interesting to ascertain if the radiant point so distinctly marked, and apparently so fixed, will in future undergo any alteration in its position. A few bright meteors were observed at Newhaven, U.S., by Herrick, on the nights of the 20–26th of October, 1839 (vide *Am. Jour. Sci.*), and were described by him as radiating from "near ε *Geminorum*." This position is more than twelve degrees from the place assigned to the present radiant point. It is not impossible that the radiant point of a meteoric shower may have altered its position to this extent in the course of nearly thirty years. Connected with the question of the possible motion of the radiant point, every available means will be taken by the Luminous Meteor Committee of the British Association, to determine as accurately as possible the position of the radiant point of the November meteors, on the occasion of their expected return on the morning of the 13th of November, 1865.

The November Meteoric Shower. By J. Glaisher, Esq. F.R.S.

[This was a verbal communication to the Meeting.]

At the last Meeting of this Society, notice was given by the President that a recurrence of the November shower of meteors was expected on the 12th of November. I believe that notice was responded to by a very large number of observers, who looked out very assiduously till the hour of 12, and then retired without occupying themselves at all about

meteors afterwards. I am not surprised at this. It is the custom of the Astronomer Royal to enter in a pocket-book, before the end of one year, all phenomena to which attention is to be paid in the following year; and if we look into these pocket-books, we shall find in every one of them, as far back as 1836, entries on certain days, "Look out for meteors;" and if we look into the Greenwich volume of *Observations* for the observations of meteors on those days, we shall find very few recorded; yet on every one of these days I have charged observers to keep a good watch on certain parts of the heavens, until at last I was almost ashamed to do so, and almost concluded that the shower-meteor theory could not be sustained.

On the night common to the 12th and 13th of November a watch was kept up at the Royal Observatory, Greenwich, from the hour of 6. Between this hour and 8^h two meteors only were seen; from 8^h to 12^h the sky was cloudy and no meteors were seen. At this time six observers (viz., W. C. Nash, A. Harding, F. Trapaud, E. Jones, T. Wright, and Lieut. Rikatcheff, R. I. N.) were located on an elevated part of the observatory. At 12 minutes after midnight the clouds began to break, and at 20 minutes to 1 the sky was free from clouds. At 1 o'clock the paths, zones, colour, and other particulars of 29 meteors, were recorded. By 2^h A.M. the same particulars of 70 additional were noted; and by 5^h A.M. the positions, &c. of nearly 280 meteors had been secured. Before this time we knew that we had abundance of observations to determine the radiant point, or points; and for a space of nearly a quarter of an hour the paths of the meteors among the stars, &c. were not noticed, but their number was simply counted. The result was that at this time meteors of the first class were appearing at the rate of 250 per hour. Now for every meteor observed, there were at the lowest estimation two or three whose positions were not recorded; so that at least 1000 meteors were visible during the hours of 1 to 5 o'clock.

At the hour of 5 the Moon was shining brightly, and many meteors were seen close to her.

Mr. Alexander Herschel was observing at Hawkhurst till nearly 3^h A.M., and he noted the positions and paths of 68 meteors, which he has laid down on a diagram, indicating very clearly a well-marked, radiant point in *Leo*.

Many of the Greenwich meteors are laid down on this diagram, and by comparing the two diagrams together it will be seen that the Hawkhurst diagram indicates the radiant point in *Leo*, within narrower limits than the Greenwich diagram. Also it will be seen that more than one radiant point is indicated in the Greenwich diagram; but they are in the same right ascension, viz., about 10^h. Now the great interest connected with this part of the results, in relation to astronomy, is that this position in *Leo* is the part of the heavens towards which the Earth was moving at this time; and apparently, as

soon as the Earth approaches this part of the heavens, those bodies situated there become luminous. This adds another link to the sciences of Astronomy and Meteorology.

I think there is no doubt that the meteors observed this night were those of the November period. At Greenwich, for more than twenty years, a good look-out has been kept for the annual display of shooting-stars at the November period, but this is the first time we have seen them. It is very likely that on several occasions we have closed our watch too early. It was the knowledge of this fact that made me say, at the beginning of these remarks, that I was not surprised at gentlemen giving up watching at 12 o'clock; for it is no joke, as I know by experience, to stand motionless on a clear, cold night, hour after hour, staring, as it were, at vacancy, with perhaps one or two observations only as a reward. It is also likely that on some occasions the shower has taken place during the day, and therefore has not been visible at Greenwich at all.

Speaking of radiant points, I may remark that there are 56 already determined and well marked. Many of these determinations have been materially influenced by isolated observations of meteors observed on the same day in different years being brought together, thus indicating the same point of the heavens as the origin of the meteors. I know nothing in physical research which seemed so unpromising as isolated observations of shooting-stars did a few years ago, yet how well a patient and painstaking record of such phenomena has been repaid.

The next step in the reduction of the observations of these meteors will be to ascertain those which have been doubly and trebly observed, so to determine their heights and velocities.

The only information I can give to-night in these respects is that with which Mr. A. Herschel has furnished me. It appears that 15 meteors observed on that night by Mr. Herschel at Hawkhurst were simultaneously observed by Professor Adams at the Cambridge Observatory. The distances from the Earth, at the beginning and end of the apparitions of five of these doubly-observed meteors, were as follows:—75 miles and 54 miles; 72 miles and 55 miles; 68 miles and 44 miles; 89 miles and 57 miles; and 114 miles and 86 miles.

These distances are somewhat greater than usual. I consider it of great importance to get simultaneous observations of other meteors; and I hope that our knowledge of the distances &c. of these bodies will be much increased by the observations of this night.

Mr. Pritchard: There is one matter I would ask Mr. Glaisher to state to the Meeting; of course the number visible of these shooting-stars depends upon the radiant point being above the horizon?

Mr. Glaisher: Yes.

Mr. Pritchard: And therefore these observations prove

how correctly the position of this radiant point is known, because, from what I gather from your communication, it appears that the maximum number of meteors occurred just at the hour that was foretold.

Mr. Glaisher: It was within one hour or so. The hour foretold was from 12 to 1 A.M.; two-thirds of that hour was cloudy. I think the President, at the last Meeting, recommended looking out for an hour or two before and after the hour of 12. I may mention that a fine display is expected on the 13th of November next year.

Mr. Pritchard: Did you see the maximum number of meteors about the time when the point of the heavens towards which the Earth was moving appeared above the horizon?

Mr. Glaisher: Most certainly; and I may add that in the six hours preceding midnight on the 12th, we saw only two meteors, and in the six hours preceding midnight on the 13th, with a cloudless sky, two meteors only were seen; thus it would seem that both before and after this time the meteors were scarce.

Mr. Pritchard: What time did that part rise?

Mr. Glaisher: Before midnight; it would be about six hours from the meridian at midnight and about two hours from the meridian at 5 in the morning.

Mr. Pritchard: And your maximum was seen somewhat after midnight certainly.

Prof. Challis: What Mr. Glaisher has said confirms my experience at the Cambridge Observatory. I often looked out for the November meteors, but could not see them. I had seen the August meteors very regularly with no very great disproportion as to the numbers; but I cannot say that I saw anything more on the 12th November than on other nights. Professor Adams has given me the particulars of his observations last 12th November. He begun at 12 o'clock, and went on to about 20 minutes past 1, and during that time I think it was 120 — at all events, above 100, that he saw. My experience of the August meteors has been this, that I never at that hour of the night got that number; so that it is quite clear, from the experience of the Cambridge Observatory, that the appearance of this last November is exceptional — a kind of shower such as we have not noticed before. I may also, perhaps, state that Professor Adams told me that he found fourteen coincidences — I think twelve certain — by comparing with Mr. A. Herschel's observations: and that the average height of the meteors they ascertained was 83 miles. I mention this because, in the year 1862, I took observations myself in the August period, and compared them with observations made at Hawkhurst on that occasion, and we got an average height of 82 miles. The number of coincidences is ten; and I think the coincidence of heights at the two periods is remarkable and worthy of notice.

Mr. Prideaux said that on the night in question he had gone with two companions to the top of Primrose Hill, and that in the forty minutes they remained there they saw seventy-two meteors. His friends were perfectly inexperienced in the matter. They arrived there about 3 o'clock in the morning. During the whole of the time that they were out, somewhere about an hour and a half, they saw nearly 120 meteors.

Observations of Occultations of Stars by the Moon, and Phenomena of Jupiter's Satellites, made at Mr. Barclay's Observatory, Leyton, N.E. By C. G. Talmage, Esq.

1865, June 28. Transit of *Jupiter's* First Satellite.

Egress.

		h	m	s	
G.M.T.	Central bisection =	10	31	3	*a*
	Last contact =	10	33	23	

1865, July 5. Disappearance of 8 *Libræ*.

G.M.T. = $9^h\,44^m\,45^s{\cdot}45$ *b*

Disappearance of α^2 *Libræ*.

	h	m	s		
G.M.T.	9	58	4·24	Mr. Barclay	*c*
	9	58	6·24	Mr. Talmage	*d*

1865, July 3. Reappearance of 8 *Libræ*.

G.M.T. $10^h\,48^m\,29^s{\cdot}46$ *e*

Reappearance of α^2 *Libræ*.

G.M.T. $10^h\,51^m\,22^s{\cdot}49$ *f*

1865, July 8. Occultation of ξ' *Sagittarii*.

		h	m	s	
G.M.T.	Disappearance =	9	21	19·13	*g*
	Reappearance =	10	11	30·88	*h*

1865, July 25. Eclipse: Reappearance of *Jupiter's* Second Satellite.

G.M.T. $10^h\,41^m\,0^s{\cdot}60$ *k*

1865, July 26. Eclipse: Reappearance of *Jupiter's* Third Satellite.

G.M.T. $8^h\,44^m\,32^s{\cdot}08$ *l*

1865, July 29. Eclipse: Reappearance of *Jupiter's* First Satellite.

G.M.T. $10\,17^m\,19^s{\cdot}43$ *m*

1865, Nov. 4. Occultation of δ^2 *Tauri*.

		h m s	
G.M.T.	Disappearance	9 57 56·93	*n*
	Reappearance	10 36 43·06	*o*

a. *Jupiter* low, but the satellite was well defined.

b. Observed with the large refractor of 10 inches aperture, with a power of 137; time exact.

c and *d*. Mr. Barclay observed the disappearance of this star with the large telescope; but he thinks the time a little doubtful. I observed it with a small telescope of $3\frac{1}{2}$ inches aperture, placed in the garden; and I feel confident in the time being exact.

e and *f*. Both stars came out very sharp at the times; the night was very clear. The colours of the stars contrasted very strongly, α^2 *Libræ* being almost white and 8 *Libræ* grey.

g and *h*. The star did not disappear instantaneously, but hung on the Moon's limb for nearly half a second, or rather it seemed to be elongated considerably. The time of reappearance is exact.

k. Observed with a power of 220 on the equatoreal; very clear and steady.

l, *m*, *n*, and *o*. The times are exact.

The eclipse of the Moon, on the 4th of October, was well seen here, but no attempts were made to take time observations; the dark limb of the Moon was apparently surrounded by a luminous streak, as noticed by Mr. De La Rue; but it did not disappear on applying higher powers; the highest used was 350, on the 10-inch refractor; this was remarked by Mr. Barclay as well as by myself.

Observations of the Comet III. 1860, *made at the Santiago Observatory, Chili.* By C. W. Moesta, Director of the Observatory.

I beg leave to transmit a series of observations of the Comet III. 1860, some of which were, I believe, sent in the year 1861. Those observations were made with a 5-feet Equatoreal, to which was adapted a ring-micrometer; but as

at that time the new building of the Observatory was not finished, the instrument could not be mounted equatoreally, and could only be placed provisionally on loose ground in a room, provided with a prime vertical opening. On account of this circumstance, I consider the enclosed observations of no great value; still, if the Comet should not have been observed at that time elsewhere in a better way, it might be deemed proper to publish them.

1860.	Santiago Mean Time.	$\Delta\alpha$. Comet—Star.	No. of Comps.	$\Delta\delta$. Comet—Star.	No. of Comps.	Comp Star.
	h m s	m s		′ ″		
July 21	7 10 49·3	+ 5 39·17	2	...	...	1
24	6 35 27·9	+ 3 49·18	3	...	...	2
25	6 53 59·2	...	...	+44 18·7	2	4
Aug. 13	9 50 27·6	+ 6 16·29	2	+40 18·5	2	5
	10 10 25·9	−10 4·87	2	...	...	6
17	9 23 59·0	− 5 25·56	2	...	...	7
	10 4 32·4	...	...	+ 47·6	2	7
	10 10 21·2	...	...	+37 35·7	1	8
18	9 17 10·8	+ 4 42·70	3	...	...	8
	9 45 36·4	...	...	+41 43·8	3	9
20	9 6 53·2	+ 3 58·87	3	...	...	10
	9 31 57·2	...	...	− 1 43·1	2	10+
	9 50 57·1	...	...	− 50·5	2	10−
23	8 54 28·6	+ 3·11	3	...	...	11
	8 54 28·6	− 2 59·39	3	...	...	12
	9 35 12·2	− 2 55·19	2	...	...	12
	9 21 3·7	...	...	+ 7 14·3	...	12
Sept. 6	7 58 34·7	− 2 51·29	3	...	...	13
	8 39 13·1	...	...	− 51·3	2	13+
	8 57 14·9	...	...	− 12·4	2	13−
7	8 4 27·2	− 40·88	1	...	...	13
8	8 32 36·3	+ 1 37·00	1	...	...	
10	9 10 21·5	...	...	+39 4·8	2	17
11	7 44 4·6	− 6 34·31	2	...	...	18
	8 16 45·7	...	...	+ 6 8·2	1	18
	8 33 19·7	...	...	+ 1 58·9	1	19+
	8 45 8·8	...	...	+ 2 44·8	2	19−
12	8 8 43·8	...	...	+ 8 1·8	2	20+
	8 27 16·8	...	...	+ 7 59·1	2	20−
13	7 26 23·8	− 1 16·64	2	...	...	21
	7 45 46·1	...	...	+ 18·0	2	21+
	8 4 29·3	...	...	+ 1 17·2	2	21−

The signs + and − in the last column indicate that the comet and the star were observed on both sides of the centre of the micrometer.

Mean Places for 1861·0 *of the Comparison Stars,*

Deduced from the Observations made with the Meridian Circle at Santiago.

No.	Star's Name.	Mag.	R.A.	Decl.	Prec. In R.A.	Prec. In Decl.
			h m s	o ′ ″		
1	Arg. O. 11830	6½	11 53 44·93	−18 53 7·2	3·060	20·05
2	Lacaille 5125	7·6	12 15 46·41	−24 6 6·0	3·031	20·01
4	B.A.C. 4253	5½	12 30 20·37	−26 22 12·6	3·160	19·88
5	ν Centauri	4	13 41 11·12	−40 59 36·0	3·569	18·13
6	λ Centauri	3½	13 57 34·71	−40 30 41·5	3·633	17·48
7	Anon.	7	14 4 52·48	−41 48 34·2	3·690	17·15
8	Lacaille 5809	7	13 57 37·04	−42 25 24·5	3·672	17·47
9	Lacaille 5826	6	14 0 15·32	−42 48 27·9	3·692	17·36
10	Anon.	8	14 3 54·82	−42 42 11·6	3·707	17·19
11	Lacaille 5918	7	14 15 51·40	−43 40 34·4	3·785	16·63
12	Lacaille 5943	7	14 18 54·12	−43 42 6·5	3·80	16·48
13	Anon.	7½	14 52 28·91	−46 27 2·7	4·033	14·64
17	Anon.	7	14 57 52·83	−47 45 26·3	4·103	14·31
18	Lacaille 6279	6	15 7 14·59	−47 20 46·1	4·13	13·73
19	Anon.	10	14 58 43	−47 17		
20	Taylor 8002	7	15 6 38·86	−47 31	4·134	
21	Taylor 7997	...	15 6 15·03	−47 33 11·1	4·133	13·79

June 2, 1865.

Observations of Solar Eclipse October 19, 1865.
By the Rev. Temple Chevallier.

I send the observed time of the first contact of the Solar Eclipse of October 19, 1865, made by Mr. M. R. Dolman, observer, for insertion in the *Monthly Notices*.

Solar Eclipse, October 19, 1865.
Observation of Time of First Contact, made at the Observatory, Durham.

1865, Oct. 19, $4^h\ 7^m\ 34^s{\cdot}7$ Greenwich Mean Time.

Good Observation.

M. R. Dolman.

Durham Observatory, Nov. 15, 1865.

Note on ζ Herculis. By T. W. Burr, Esq.

In the last number of Vol. XXV. of the *Monthly Notices*, Mr. Fletcher draws attention to the fact that the above star, which with his large refractor is now "absolutely single," was a few years ago measurable with a telescope of 4 inches aperture only. This reminded me that I had seen it double with even less aperture, and thinking the period of this observation might be interesting I have referred to my note-book, and find that on the 19th May, 1853, I saw the pair well separated with a power of 480 on my Ross Equatoreal of $3\frac{3}{8}$-in. aperture, and that even with 173 the duplicity could be detected.

I did not apply the micrometer then, but some measures by Mr. Miller in the *Notices* for the same month gave $1''{\cdot}4$ for the distance.

Islington, Dec. 7, 1865.

Physical Constitution of the Sun. By Lieut. E. D. Ashe, Director of the Quebec Observatory.

The author states that his observations were made with a telescope of 8 inches aperture, 9 feet focal length, mounted equatoreally, driven by clock-work, and being one of Alvan Clark's superior telescopes. The power generally used was 400. He also states that the atmosphere of Quebec for astronomical observations is not second to that of Italy. He remarks that there are difficulties to overcome in the cavernous view of the question that he thinks are insurmountable.

He explains his own theory as follows:—I conceive the Sun's surface to be composed of an equally bright and incandescent photosphere, that our Sun is a nebulous star, and that the nebula consists in what is seen as the zodiacal light; that the spots are small meteor planets that revolve round the Sun, and that they fall into it; at first they are not visible even to the largest telescopes, but after they meet and spread out they cover comparatively a large surface. When they crack and split into pieces they show the bright surface of the Sun called bridges; that the penumbra is the dross or thinnest portion of melted matter, which when further attenuated breaks up into patches, and finally forms the darker portions of the granulations that cover the surface of the Sun. The faculæ are nothing more than the disturbance of this scum, showing the brighter portion of the Sun's surface, which disturbance must take place in the neighbourhood of these boiling, melting masses; also, that there is a drift, as mentioned by Mr. Carrington, which

carries the faculæ away and distributes the scum over the entire surface of the Sun. And he adduces arguments, supported by references, that may sustain his view of the question.

M. Chacornac, in a letter dated 24 October, 1865, addressed to the President of the Society, refers to the continuation of his researches on the physical constitution of the Sun; and states that after various observations he has arrived definitively at the conclusion that the Sun is at least as luminous at its centre as in the brilliant envelope which bounds its visible contour ("que le Soleil est au moins aussi lumineuse à son centre que dans cette enveloppe resplendissante qui limite son contour visible").

Observations of Double Stars. By the Rev. Padre Secchi.

July 20, 1865. I measured the star δ *Cygni*, and found $P = 348°{\cdot}45$, $D = 1''{\cdot}465$.

July 20, 1865. γ *Coronæ* is round only occasionally; it seems there is a notch in direction 85°.

ξ *Herculis* likewise is round; in the best moments a notch appears in the disk on Dir. 315°.

51 ξ *Libræ*, A.B., Pos. = 155°, Dist. $0''{\cdot}40$, disks well separated.

Rome, Nov. 24, 1865.

The Society has received from Mr. A. Brothers a sheet of photographs of the Moon, taken during the Eclipse on the 4th Oct. with his Equatoreal telescope of 5 inches aperture. Mr. Brothers writes that the prints must not be looked upon as photographs of the Moon, as many very much superior have been taken, but merely as pictures of the Eclipse. The atmosphere was so much disturbed during the whole time of the Eclipse that the sharpness of detail is lost to a great extent. He attempted to obtain the entire outline of the Moon, but failed to get more than greater sharpness of the shadow; this will be seen in No. 10, which was exposed 15 seconds; Nos. 8 and 12 were exposed 3 seconds, and the remainder from 1 to about 2-tenths of a second.

Observations of Encke's Comet. By G. R. Smalley, Esq.

(*Extract of a Letter addressed to the Astronomer Royal.*)

I send the approximate places of Encke's Comet, deduced from four sets of observations (such as they were) in June and July last. There were but four nights when I could see the Comet at all, and then observation was most difficult, and, from the absence of any appearance of condensation, bisection almost impossible.

Hitherto I have had no means of identifying the stars of comparison, and the results I send you are corrected for refraction and instrumental errors only.

Approximate Places of Encke's Comet (corrected for refraction), 1865.

Date.	Sydney Mean Time.	R.A.	South Declination.
	h m s	h m s	° ′ ″
June 28	7 14 6·9	8 26 19·8	10 49 2·0
29	7 4 59·0	8 34 59·3	12 58 54·5
30	7 18 39·7	8 44 14·5	15 14 56·5
July 1	6 51 0·6	8 54 13·3	17 32 36·6

Comet very faint throughout.

No appearance of any nucleus or tail—a mere faint patch of haze.

Government Observatory, Sydney,
Sept. 22, 1865.

Occultations of Stars by the Moon, observed at Forest Lodge, Maresfield. By Capt. W. Noble.

Monday, July 3d, 1865.

8 *Libræ.*

The star disappeared instantaneously at the Moon's dark limb

at $16^h\ 33^m\ 50^s{\cdot}3$ L.S.T. = $9^h\ 46^m\ 8^s{\cdot}7$ L.M.T.

and reappeared at the bright limb

at $17^h\ 35^m\ 48^s{\cdot}4 \pm$ L.S.T. = $10^h\ 47^m\ 56^s{\cdot}7 \pm$ L.M.T.

α^2 *Libræ* disappeared instantaneously at the Moon's dark limb

at $16^h\ 47^m\ 26^s{\cdot}8$ L.S.T. = $9^h\ 59^m\ 43^s{\cdot}0$ L.M.T.

and reappeared also instantaneously at the Moon's bright limb

at $17^h\ 39^m\ 13^s{\cdot}0$ L.S.T. = $10^h\ 51^m\ 20^s{\cdot}7$ L.M.T.

At the times of emersion the bubbling and boiling of the air was very great, and this renders the reappearance of 8 *Libræ* slightly uncertain.

Power employed 135 upon the micrometer, with of course a positive eye-piece. It was adjusted upon the stars.

Saturday, November 4.

δ^2 *Tauri.*

The disappearance was not observed; but the reappearance took place instantaneously at the Moon's dark limb

at $1^h\ 34^m\ 4^s{\cdot}5$ L.S.T. = $10^h\ 37^m\ 21^s{\cdot}8$ L.M.T.

Power 255 adjusted on the star.

Sunday, November 5.

115 *Tauri.*

The star disappeared somewhat sluggishly at the Moon's bright limb

at $1^h\ 19^m\ 17^s{\cdot}9$ L.S.T. = $18^h\ 8^m\ 43^s{\cdot}4$ L.M.T.

The reappearance was not observed.

Power 255 adjusted on the star.

In each case the telescope employed was my Ross Equatoreal of 4·2 inches aperture and 61 inches focal length.

Forest Lodge, Maresfield, Uckfield,
November 9, 1865.

Observations of the Solar Eclipse, October 19, 1865.
By Lord Wrottesley.

The commencement of the Solar Eclipse of the 19th of this month was here observed to take place at $4^h\ 2^m\ 3^s$ Wrottesley Mean Time. Instrument, the 11-feet Equatoreal; observer, Mr. Hough.

The observation was not very satisfactory, as the eye of the observer was not directed to that part of the limb of the Sun, on which the first impression was made, at the instant of

contact; but Mr. Hough is satisfied that the time above given is not more than 6^s too late.

The Sun was at times obscured by clouds, and the limbs of both Sun and Moon were exceedingly tremulous. The two great spots near the edge of the limb added much to the interest of the phenomenon.

Wrottesley, Oct. 29, 1865.

Notice of a recent Memoir of Prof. Krueger, of Helsingfors, on the Star-cluster in λ Persei. By R. C. Carrington, Esq.

Prof. Krueger has recently sent copies to this country of the memoir above named, and accompanying my copy has written me a request that I would call the attention of the Society to a conclusion to which his researches have led, and which he considers to require re-investigation by an independent person. Regarding the example of Bessel in very carefully recording the relative positions of numerous principal components of the Pleiades as one to be followed in other similar cases, he has in similar manner by heliometric observations ascertained, and placed on record the relative positions of 43 stars in λ *Persei*, by referring them in distance and position to a double star *d* which he took for his zero-point; and a catalogue and chart and particulars of reduction and theory are appended. He has further divided his results into two groups of Spring and Autumn, results between which a difference comes out which would (if no instrumental influence vitiates the conclusion) imply a position parallax of the cluster of $\frac{2}{3}$rds of a second as referred to the double star, or that the double star *d* the components of which are of the ninth magnitude is situated considerably behind the cluster of which optically it appears a component. As there is an inherent improbability attached to this conclusion, Professor Krueger suspends his judgment till he is able to further examine the question, and lays the result before others as an interesting case for independent investigation.

It needs no remarks from me in addition to his own to urge the desirability that this should speedily be done by those who possess the opportunities and necessary qualifications for so delicate a research; but I would take the opportunity of remarking that several other clusters offer similar fields of useful labour to those members of the Society who, though not prepared to enter on researches requiring many continuous years of application, are yet willing to take up subjects of more moderate extent.

Dec. 1865.

The Time-signalling Operations at Glasgow. By Prof. Grant.

The President at the conclusion of the Meeting, called upon Professor Grant of Glasgow, who was present, and who has been making some successful experiments in distributing time over the city of Glasgow, to give an account of his operations.

Professor Grant stated that, in the time-signalling operations at Glasgow, Jones's method of regulating clocks is exclusively used. It is generally known that, according to this method, the electric fluid is employed merely as a regulating agent, and not in any case as a motive power, the time-piece under control being an ordinary clock, connected by a regular succession of electric pulsations with the normal mean-time clock of the Observatory. The application of the invention in Glasgow has been perfectly successful. It has been employed under various forms; but what Professor Grant considered to be the most suitable to the requirements of a large city was the small clock with a seconds' pendulum and a dial of about 3 feet in diameter, showing the time to hours, minutes, and seconds. Clocks of this construction have been set up in the public thoroughfares of Glasgow, and have been found to be exceedingly useful. Attached to each of them is a galvanometer, which, by its deflections, gives an indication of the electric currents transmitted in successive seconds from the normal mean-time clock of the Observatory, and a break in the transmission of the currents, once in every minute, namely, at the sixtieth second, of the Observatory clock, supplies the public with an unerring criterion for testing the accuracy of the controlled clock. There were now eleven clocks of various forms in Glasgow under the electric control of the mean-time clock of the Observatory. In a short time the number would be increased to some seventeen or eighteen, and the system was gradually extending over all Glasgow. The going of these clocks was truly marvellous. From week to week and from month to month they continued to indicate the time with the utmost precision, occasioning merely a little attention now and then to the battery power. It was one of the advantages of Jones's method of control that, even in the case wherein the operations were on an extensive scale, only a small amount of battery power was necessary. There was one other remark which he would make, and it had reference to turret-clocks. Hitherto it had been usual, in the operations for placing one of such clocks under control, to remove the two seconds' pendulum, and to substitute for it a seconds' pendulum, which was made to beat in exact unison with the pendulum of the Observatory clock. Objections to this practice have been expressed by many persons who consider that a heavy pendulum vibrating once in two seconds is much better adapted than a light seconds' pendulum for maintaining the steady going of a

clock fitted up in a lofty tower, the dials and hands of which are necessarily exposed very much to the action of high winds. After a good deal of experiment, Professor Grant found that the two seconds' pendulum might be retained and kept under complete control by attaching a larger wire coil to the bob, and using a more powerful system of magnets in combination with it.

Mr. Pritchard: Do you mean that you control at once pendulums that beat a second and pendulums that beat two seconds by the same wire?

Professor Grant: Yes. We have two turret-clocks in which the long pendulum has been removed and the short one substituted; but we have a third one in which the long pendulum has been retained, and the result has been completely successful. Nothing can be more satisfactory. It goes on from week to week without any trouble, and the result is as exact as in the case of the smaller clocks.

Letter to the President from Dr. Donati, Director of the Observatory, Florence.

"*Florence, le 27 Dec.*, 1865.

"Si l'on compare les éléments, que j'ai calculé pour la Comète que le Rev. P. Secchi annonça d'avoir trouvée le 9 courant, avec les éléments de la Comète de Faye, on s'aperçoit que la Comète annoncée par le P. Secchi n'est autre chose que la Comète de Faye.

"Peut-être vous avez déjà fait cette remarque, que je n'avais pas faite d'abord, en partie à cause de l'annonce donnée par le Rev. P. Secchi, et en partie parcequ'il était réellement peu presumable que dans ces jours on pût observer de nouveau la Comète de Faye."

ERRATA.

Vol. XXV., p. 56, end of line 13, and lines 15, 20, 23, and 25, and p. 57, line 10, *for* α *read* 2α.

Vol. XXVI., No. 1, page 34, line 11, *for* which surpassed, *read* that of Mr. Rutherford surpassed.

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